WATERSHED PROCESSES AND WATER RESOURCES

Panel Manager – Dr. Albert Clemmens, USDA-ARS, Phoenix, AZ
Program Director – Dr. Nancy Cavallaro

A sustainable and reliable source of fresh water in both natural and managed watersheds is vital for the continued production of food and fiber. Research in the Watershed Processes and Water Resources Program is aimed at two interrelated areas: (1) Understanding the fundamental processes and watershed characteristics controlling the origin, transport, and fate of water, sediment, nutrients, dissolved matter and biological organisms from forests, rangelands, and agricultural environments, and (2) Developing management and technology for consumptive and non-consumptive uses that affect quantity and quality of water in agriculture and forestry production.

2001-01082 Ground Water Vulnerability Delineation Using Neural Networks, Fuzzy Logic and Neuro-Fuzzy

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Grant 2001-35102-10830; $305,000; 3 Years

Contamination of ground water (GW) by agricultural chemicals is a major concern of many rural citizens and state and federal agencies involved with the management, quality and quantity of water and human health. Since testing of water quality of all domestic and irrigation wells within large watersheds is not economically feasible, delineation of those wells within highly vulnerable GW areas will be useful for health and regulatory agencies. One frequently used monitoring strategy is to develop maps of the vulnerable areas of GW and prioritize those wells located in those vulnerable areas for testing for agricultural contaminants such as animal waste components, fertilizers, and pesticides. However, generation of vulnerability maps or delineation of the vulnerable areas for monitoring purposes is difficult since GW contamination depends upon numerous, complex interacting parameters with inherent spatial and temporal uncertainty. Therefore, development of an affordable but robust technique to predict GW vulnerability at the watershed scale with minimum inputs of field data will be a useful GW management tool. The objectives of this research are to examine the prediction of GW vulnerability to agricultural chemicals at the watershed scale by developing and adapting Neural Networks, Fuzzy Logic and Neuro-fuzzy models in a GIS platform. These new techniques were chosen because they provide robust but economically feasible tools to generate GW vulnerability maps for policy makers. This research will use existing state and federal digital data for soils, landuse, geology and water quality data from 450 georeferenced wells in the Mississippi Delta region of Arkansas.

2001-01170 Fundamental Processes Governing the Aquifer Characteristics of the Kern Water Bank: Implications for other Alluvial Fan-type Aquifers in Agricultural Regions with Arid to Semi-Arid Climates

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Standard Strengthening Award; Grant 2001-35102-11030; $151,000; 3 Years

The purpose of this project is to enhance the efficiency of subsurface water banks in arid/semiarid settings by investigating the relationship between the characteristics of aquifers and fundamental depositional models. Our work will facilitate the planning and development of new water banks throughout the western U.S. and beyond by enabling the prediction of zones of desirable aquifer characteristics from regional depositional models and by exemplifying the cost-effective use of modern reservoir software in the 3-D analysis of aquifers.

Our project begins with the 3-D mapping of an ideal case study (the Kern Water Bank) using 1) an existing, extensive database consisting of a) electric logs and other data from approximately 200 wells and b) seismic data donated by the local petroleum industry, and 2) state-of-the-art reservoir software available at our GeoTechnology Training Center (e.g., Geographix™ and/or Landmark™). Using this mapping product we will next develop a regional depositional model based on existing sequence stratigraphic depositional models for the basin from underlying sedimentary units and the expected additional influence of Quaternary climate change on the nonmarine setting characterizing the sediments of the Kern Water Bank. The relationship of aquifer characteristics will be tied directly to this model using existing water quality data and ICP-MS analyses of cuttings from wells.

If successful with this first stage of our project, we will apply for further funding to test the depositional model and its relationship to water quality by taking and analyzing two cores. One core will be from a terminal basin (Buena Vista Lake) which will hold the most complete record of deposition for the entire Kern River alluvial fan system. Given the completeness of record for this core, we will use it as a link to the established global climate change record for the Quaternary Epoch. The second core will be from the Water Bank, itself. Using independent means of correlation, we will tie the Water Bank core both into the first core and into the 3-D mapping of the Water Bank thus testing our climate-influenced model of deposition and related water quality.

The mapping product will also be used as a robust set of boundary conditions for a hydrological flow model of the Kern Water Bank

2001-01109 Decontamination of Acetanilide Herbicides with Thiosulfate Salts

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Grant 2001-35102-10861; $235,000; 3 Years

Acetanilide herbicides such as alachlor, metolachlor and acetochlor are among the most heavily used herbicides in the U.S. Because of their widespread use, these herbicides are a ubiquitous source of contamination of soil and water resources. Contamination of groundwater by these herbicides is of particular concern because these compounds are potentially carcinogenic and exposure to them may cause serious health problems. We discovered a novel reaction, in which chloroacetanilide herbicides are dechlorinated and detoxified by thiosulfate salts. Addition of ammonium- or sodium thiosulfate to herbicide-contaminated sand columns reduced herbicide leaching by up to 99%. Because common thiosulfate salts are fertilizers or otherwise inexpensive products, this finding has great promise for practical implementation in many contaminant management scenarios, such as for wastewater treatment, spill cleanup, container decontamination, and remediation of polluted aquifers. The proposed research will evaluate the feasibility and conditions of using thiosulfate salts to decontaminate acetanilide herbicide residues from soil, water and aquifers. This research has a great probability of success

because the hypothesis is based on an innovative but sound scientific approach. Development of this application will provide an effective tool for preventing and remediating environmental contamination of a number of heavily used herbicides, which can contribute greatly to the long-term partnership between agricultural sustainability and environmental protection.

2001-01056 Natural Attenuation of *Cryptosporidium parvum* During Transport in Watersheds

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Grant 2001-35102; $320,000; 3 Years

Animal operations have been implicated as one of the primary sources of the human pathogen Cryptosporidium parvum (C. parvum) in streams. As a result, agricultural operations have been increasingly forced to implement strategies to control pathogen delivery to surface waters. Requirements for best management practices (BMPs) such as buffer stripes are based on the assumption that pathogens may be readily transported to downstream water supply intakes once runoff reaches a stream. However, recent evidence suggests that pathogen transport in streams is mediated by interactions with suspended and bed sediments. This implies that there may be a significant in-stream attenuation of C. parvum concentrations before agriculturally derived waters enter downstream water supply systems. In this project, we examine the in-stream attenuation and net downstream transport of viable C. parvum oocysts in surface waters. Innovative laboratory experiments will specifically examine C. parvum association with natural sediments, deposition in streambed sediments, downstream C. parvum transport, and the effect of suspended particle interactions on C. parvum viability in streams. On the basis of these experiments, tools will be developed to predict the net attenuation of viable C. parvum oocysts between upstream agricultural discharge points and downstream surface water supplies. Our work will support efforts by the dairy, swine, and livestock industry, by agricultural and urban planners, and by decision makers providing them with improved tools for assessing and managing C. parvum transport in watersheds.

2001-01068 Evaluation of Enhanced Bank Stabilization Structure for Reducing Nutrient Contamination

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Grant 2001-35102-10777; $275,000; 3 Years

Nitrate in groundwater and surface water is a significant environmental issue throughout the United States, particularly in agricultural areas. With phosphate, nitrate in surface waters is a significant concern for the environment since excessive levels of either microbiological nutrient can lead to uncontrolled growth of algae. Excessive growth of algae lowers the water's oxygen concentration and limits the number and type of animal species that survive. An example of excessive nutrient levels causing environmental harm is the hypoxia phenomena that are experienced in the Gulf of Mexico. High concentrations of nitrate from the Mississippi River result in excessive algal growth leading to daily cycles of oxygen depletion and minimal aquatic life in a zone around the river's mouth.

One of the sources of nitrate influent to the Gulf (and other lakes and reservoirs throughout the country) is fertilizers that are applied to agricultural land. Nitrate travels with the

groundwater to receiving streams and downstream bodies of water. Research has shown that healthy riparian zones naturally remove much of the nitrate and prevent pollution of streams, lakes and reservoirs.

This research will evaluate the feasibility of using modified bank stabilization structures to reduce nitrate and phosphate concentrations in groundwater and surface-water infiltration and runoff before contamination of streams can occur. The goal is to develop relatively inexpensive construction modifications to bank stabilization structures that serve to collect groundwater and surface-water runoff, and divert these flows through an artificial "riparian" zone and naturally remove nitrate and phosphate.

2001-01111 Bacterial Source Tracking to Identify Nonpoint Fecal Pollution in Agricultural Watersheds

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Grant 2001-35102-10790; $310,000; 2 Years

Many waters in agricultural areas experience fecal contamination, resulting in increased health risks and degradation of water quality. Because fecal bacteria used as water quality indicators are shed in the feces of humans and animals, it has been difficult to identify sources of fecal pollution. Bacterial source tracking (BST) makes such identifications possible. BST methods require (1) a reproducible "fingerprinting" technique to differentiate strains of indicator bacteria such as *E. coli* and (2) generation of a representative library of indicator bacteria fingerprints from the animal and human sources that may impact waters. Indicator bacteria fingerprints from polluted waters are then compared to those in the library, and assigned to the appropriate source category based on fingerprint similarity. Knowing the sources of microbial pollution in water is important for accurate risk assessment, to identify and eliminate point source pollution, and to establish land management practices that decrease contamination from nonpoint sources.

This project compares three BST methods using *E. coli* and *Enterococcus*; one based on antibiotic resistance analysis, and two based on DNA fingerprints (ribotyping and pulsed field gel electrophoresis). The merits of these methods will be compared by (a) accuracy, cost, and processing time; (b) determining the geographic range of the libraries, and (c) assessing the methods' utility in field experiments. Successful implementation of best management practices (BMPs) and calculating total maximum daily loads (TMDLs) in agricultural watersheds will depend upon accurate source identification (e.g. human, wildlife, or livestock). This comparison and development of BST methodology will refine BMP implementation, focussing resources on the actual pollution sources watersheds.

2001-01085 Impacts of Landscape Change on Variable Saturation Areas in a Humid Subtropical Environment

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Grant 2001-35102-10829; $165,000; 3 Years

Variable Saturation Area (VSA) is the zone containing water saturated soils in forested wetlands along the flood plains of thousands of miles of creeks and rivers in Florida and the Southeast. This inundated zone occurs in topographically low areas where it receives regional discharge fluxes from surrounding landscapes. As the name implies, VSA varies with time - the

saturated area shrinks during the dry season, and expands through the wet season creating the forested wetland hydroperiod, a fundamental characteristic controlling plant species in the wetland. The objectives of this project are (1) to model and physically measure landscape characteristics which enhance the formation of a VSA, (2) to understand the hydrological dependence of a VSA on surrounding landscapes and on the regional seepage fluxes from these landscapes, and (3) to model the impact of agricultural and urban land uses upstream on the hydroperiod of VSAs.
At the dawn of the twenty-first century, economic prosperity is bringing rapid agriculture and urban land developments to many counties in Florida. Yet, we do not fully understand how to accommodate this development which continues to fringe VSA. This research will help set scientific foundations for analyzing the impacts of land use change on the hydrology of forested wetlands.

2001-01160 Assessing the Vulnerability of Farmstead and Rural Domestic Wells to Agrichemical Contamination

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Grant 99-35102-8551; $66,000; 1 Year

To goal of this project is to assess the vulnerability of farmstead and rural domestic wells to pesticide and nitrate contamination. The rural domestic wells do not come under any regulatory compliance for water quality testing. Periodic testing of individual wells is not feasible due to cost and logistics. However, the assessment of vulnerability of these wells, using the data from some large-scale studies in the midcontinental and southeastern United States and the National Water Quality Assessment (NWQA) Program of the US Geological Survey is proposed. The Phase-1 funding for this project covered feasibility studies for areas in the midcontinental United States and the Phase-2 scope will cover the southeastern United States. Artificial Neural Networks (NN) will be used for vulnerability assessment utilizing the occurrence data of nitrate and pesticides, well site land use information, well construction details, and other climatic, hydrologic and geologic data. Our initial results from Phase-I investigation appear to be positive. The Phase-2 effort will enable us to include more data to our database. A major focus will be to use studies with varying amounts of information data. Once more esticide and nitrate occurrence data become available along with site information, the NN model can be used to predict contamination potential for new sites with adequate site and hydrologic data. The identified high-risk sites can be taken up for confirmatory sampling by the health or regulating agencies and the well users can be informed about the water quality. Potential cost savings can be realized by testing only the most vulnerable wells.

2001-01062 Influence of Cold-season Processes on Runoff Generation in a Semi-arid Watershed

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Standard Strengthening Award; Grant 2001-35102-11031; $180,000; 2Years

The path that water takes through a watershed to a stream depends on the source of the water (precipitation, soil moisture, or groundwater), and the transport mechanism (overland flow or subsurface flow). That path dictates numerous critical watershed properties including flooding hazard. Snow and frozen ground can alter such pathways. Prediction of streamflow in basins that

experience different combinations of snow and frozen ground at different elevations is therefore difficult. The objectives of this project are to determine the hydrologic pathways under various combinations of snow and frozen soil at different elevations within a basin, and then determine the proportions of high and low elevations that contribute to streamflow throughout the year. These objectives will be accomplished by implementing a field program consisting of water budget and chemical tracer studies in two sub-basins at different elevations in the Dry Creek watershed near Boise, Idaho. The high elevation site will experience persistent winter snow packs with occasional winter rains over unfrozen soil. The low elevation site will experience combinations of frozen ground, rain, and snow. Each site will be instrumented to monitor soil temperature, soil moisture content, hydraulic head, overland flow, precipitation, and streamflow, soil water chemistry, and stream chemistry. Applied and natural chemical tracers will be used to decipher flow paths at the hillslope sites and to determine portions of the basin contributing to streamflow at the watershed scale. The information generated in this study will be used in the future to test and calibrate streamflow prediction models for semi-arid watersheds.

2001-01171 Monitoring the Quality of Groundwater Impacted by Swine Production Facilities

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Grant 2001-35102-10774; $300,000; 3 Years

Increases in animal production have raised environmental quality issues concerning the effects of animal waste disposal currently used in agriculture. A common practice is the use of on-site abatement lagoons or deep pit systems to store wastes. These storage structures can leak or seep contents into the ground beneath, creating a risk for bacterial contamination of the underlying groundwater system. Few studies have addressed groundwater fecal contamination, including pathogenic bacteria, and more significantly, that the contamination may be traced to agricultural origins. In this study, we propose to conduct a three-year study to monitor the presence and distribution of fecal indicators in groundwater underlying two swine production facilities with different geology. This study will be unique in that we will use molecular-based methods. We further propose a new molecular fingerprinting method using antibiotic resistance gene profiles to trace bacterial contaminants in groundwater to an animal production facility. These molecular-based methods will be more rapid, result in higher sensitivities for detection of specific viable bacterial species, and provide genotypic information that culture-based methods lack. Two swine production facilities have been identified for possible study. These sites are part of an ongoing study by the Illinois State Geological Survey, and have already been extensively characterized hydrogeologically, and monitored for both inorganic nutrients and fecal contamination. The studies proposed here will determine the extent, persistence, and distribution of agricultural contaminants in groundwater systems, and their source; data which are crucial in part, to understanding fundamental processes of bacterial and inorganic contaminations in watershed systems.

2001-01070 Understanding Hydrologic and Water Quality Response of a Tiled Watershed

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Grant 2001-35102-10789; $290,000; 3 Years

Tile-drained watersheds contain much of the productive agricultural land in the north central United States, yet the hydrology of these watersheds is not well understood. True surface runoff rarely occurs from these watersheds; most of the water in streams comes from through tile drains and/or the stream banks. This research is critical for understanding fundamental processes of how water reaches the stream and how much comes from tile, stream bank, and runoff (if any). If it is found that certain land use and/or agricultural production practices on tiled fields worsen the nitrogen contamination of surface waters, then these practices can be modified to reduce their impact. Without knowledge of how the water flows within a tile-drained watershed, modifications (or regulations) would need to be broadly applied, rather than targeted to specific areas. This study will open a whole new dimension for watershed management to improve water quality in tile-drained watersheds. Once our techniques and relationships are validated, the estimation of total maximum daily load (TMDL) to a surface water source will be simplified and accurate. Accordingly, watershed management practices can be evaluated and applied to comply with the TMDL criteria for tile-drained watersheds. Overall, the results of this study will be utilized for better management of agricultural practices in east central Illinois and similar areas with tile-drained watersheds.

2001-01101 Factors Controlling Stream Denitrification in an Agricultural Landscape

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Grant 2001-35102-10789; $315,000; 3 Years

The movement of nitrogen from agricultural areas in the Midwest to the Mississippi River and Gulf of Mexico has become an environmental concern in recent years. Excess nitrogen creates problems for drinking water supplies and contributes to the dead zone (hypoxic zone) in the Gulf of Mexico. Currently, the processes involved in the movement of nitrogen through streams and rivers are not fully understood, making it difficult to systematically account for all the nitrogen leaving agricultural watersheds in the Midwest. Denitrification is a microbial process that removes nitrogen from aquatic ecosystems by converting nitrate to nitrogen gas. Exactly how much nitrogen is removed by denitrification in the small streams of the Midwest is unknown, but initial research suggests it could be substantial. Our research will measure rates of denitrification (i.e., nitrogen loss) in several small agricultural streams in the Midwest with the goal of determining the relative importance of denitrification in removing nitrogen from these water bodies. Additionally, we will examine the environmental factors that might limit the potential of denitrification to remove nitrogen from small streams. We believe other processes occurring in these streams, such as photosynthesis by algae, may be restricting the amount of nitrogen being removed via denitrification. If so, current estimates of nitrogen loss from agricultural watersheds will likely be in error. Our research will involve a variety of methods and techniques that should allow us to improve the estimates of nitrogen loss from the Midwest by specifically addressing the role of denitrification in small streams.

2001-01091 Quantification and Evaluation of Subsurface Water Dynamics for Determining Water and Chemical Fluxes on Adjacent Watersheds

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Grant 2001-35102-10780; $240,000; 3 Years

Fundamental processes governing the movement of agricultural chemicals through soil to neighboring ecosystems are so poorly understood that strategies for mitigating contamination cannot be accurately formulated. The major limitation to accurately determining chemical transport at the watershed scale is our inability to identify subsurface locations where water and agricultural chemicals converge to form discrete loss pathways. Geophysical measurements and geospatial analysis are being linked in this study to determine where and when water and chemicals are flowing in discrete subsurface pathways. The Beltsville, Maryland research site is less than 30 ha, yet still large enough to capture the spatial variability of crop and soil parameters encounter by many farmers. The results from this study will be used to develop methods for identifying surface and subsurface chemical loss pathways into ecosystems surrounding agricultural lands and to develop environmentally friendly and economically beneficial farming practices.

2001-01100 Restoring Degraded Stream Corridors Using Woody, Riparian Vegetation: An Experimental Study

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Grant 2001-35102-10788; $104,000; 3 Years

The restoration and rehabilitation of biologically impaired, degraded stream corridors is an essential component of managing, preserving, and conserving the nation's water and agricultural resources. River restoration programs seek to return biological functionality to degraded stream corridors primarily through enhancement of habitat, habitat resources, and stream channel stability. Restoration projects, along with streambank stabilization and protection programs, have used vegetation extensively to accomplish these goals, and such bioengineering techniques have great environmental appeal. While many studies have discussed the effects of riparian vegetation on flow and sediment transport, none has utilized vegetation for the purpose of inducing a straight stream to meander, a technique that could potentially restore hundreds of streams typical of the South-central U.S. The present proposal seeks to examine the utility of emergent riparian vegetation for the purposes of altering stream channel planform and rehabilitating degraded stream corridors. This will be accomplished by physically modeling a degraded stream channel in an experimental flume and using managed vegetation to trigger the desired morphological and ecological adjustments and effects. The specific objectives of the study are: (1) to demonstrate the trapping of sediment within the vegetation zones and the growth and development of bars, (2) to demonstrate the onset and development of a meandering stream pattern, and (3) to test a formulation for calculating the total flow resistance by the vegetation on the stream flow.

2001-01139 Fundamental Analysis of a Novel Swine Wastewater Treatment Technology

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Grant 2001-35102-10783; $320,000; 3 Years

Environmental concerns in current swine waste treatment operations need to be addressed by developing alternative treatment technologies that will not only remove organics, but also manage nutrients. In swine wastes, nitrogen is a key nutrient: nitrogen mismanagement has led to problems such as excessive ammonia emissions, algal blooms in surface waters, nitrates in

drinking water sources, and outbreaks of harmful organisms that cause fish kills. We propose to study the fundamental microbiology and performance of a novel biological treatment system that has shown promise as an alternative to swine lagoons. A key component of the treatment technology is a reactor that alternates between aerated and non-aerated conditions. This operation allows microorganisms to convert ammonia to nitrate, and then subsequently convert nitrate to harmless nitrogen gas within a single reactor. To understand and optimize the nitrogen-removal mechanisms occurring in this reactor, the fundamental relationships of the microbial populations to reactor operation will be studied. The research approach will combine molecular (nucleic acids-based) methods for identifying and quantifying key microbial groups with controlled lab-scale reactor studies. This combined molecular and engineering approach will increase our fundamental understanding of the process, which will in turn lead to better design and operation guidelines and more effective adoption of the technology.

2001-00600 Developing a Geographical Information System for Regional Environmental Analysis

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Equipment Grant; Grant 2001-35102-10995; $9,348; 1 Year

A Geographic Information System (GIS) is a package of computer hardware, software, and geographic data which enables the user to efficiently input, store, update, retrieve, manipulate, analyze and display spatial information. The Allegheny College Environmental Science Department is building a GIS for regional environmental and resource management analysis. Allegheny College is located in northwest Pennsylvania, where land use is almost evenly split between agriculture and northern hardwood forests, and where much of the forest acreage is owned by farming families. Using GIS, the Environmental Science Department will work with resource managers in the region on development of best management practices for farming and forestry. The departmental CIS win allow for analysis of such issues as changes in forest cover, soil, erosion management, riparian zone creation, wetland management, and agricultural water quality. The grant will allow for the purchase of computer workstations and GIS software for use by faculty and students in regional resource management research.

2001-01069 Assessing the Risks to Ground and Surface Waters from N- vs. P-based Manure Application Strategies

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Grant 2001-35102-10782; $295,000; 4 Years

Nutrient losses from agricultural land receiving animal manure contribute to accelerated deterioration of ground and surface waters. This project is designed to investigate how N- vs. P-based manure application to annual vs. perennial crops affects nitrate and P leaching from the crop root zones, N and P losses in surface runoff, and crop removal and soil accumulation of the nutrients. An experimental field with replicated strips of corn, alfalfa, and orchardgrass has been established. Dairy manure is applied at rates meeting the N or P requirement of each crop; fertilizer and control treatments serve as comparisons. Wick and pan lysimeters will be used to collect leachate for determining nitrate and P leaching losses. Runoff collection devices will be installed for estimating runoff losses of N and soluble and sediment-bound P. Seasonal and

rotational changes in nitrate and P distributions in the soil profile will be monitored; crop yield and nutrient utilization efficiency will be determined. We will also integrate animal agriculture nutrient management into veterinary education. The project will generate comprehensive, quantitative data on N and P losses in both leachate and runoff when manure is applied at two contrasting rates to annual and perennial crops on the same site. Such data will provide much needed information for devising cost effective and rational decisions on how best to manage the vast amount of manure nutrients for protecting waters while sustaining animal agriculture.

2001-01123 Advances in Stochastic Wind Modeling for Wind Erosion Estimation

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New Investigator Award; Grant 2002-35102-11585; $98,049; 3 Years

This research proposes to develop new stochastic wind models, as well as to improve and apply existing stochastic wind models to the problem of wind erosion estimation in the presence of climatic variability. In particular, we propose to investigate and model the dependence of the wind velocity (as a random variable) on precipitation, estimating a joint distribution of the two quantities for sites throughout the Great Plains of the U.S., as a function of month of the year and hour of the day. The extent to which inclusion of the precipitation-dependence affects estimates of wind erosion will be tested using the Wind Erosion Prediction Systems (WEPS). The impact of climatic variability on wind is proposed to be investigated through the search for trends in the average and variability of the wind and the dependence of these on known large-scaling climatic forcing phenomena such as ENSO. The results of this research should improve the accuracy of wind input to wind erosion models, thus improving their utility for land use management, and will further aid in land use management through its assessment of trends and variability in aspects of climate important to wind erosion.

2001-01110 Three Dimensional Characterization of Soil and Hydraulic Properties for Water Quality Assessment

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Grant 2001-35102-10779; $155,000; 2 Years

Data describing spatial variability of soil hydraulic properties necessary for assessing water and solute fluxes at a landscape or watershed level are often lacking. The proposed project is directed to develop an innovative geostatistical and 3-D landscape-based approach for quickly creating a soil data set within a watershed or closed basin for assessing and modeling water and solute fluxes. The objectives of this research include, (1) to determine the feasibility of using a profile cone penetrometer (PCP) equipped to measure soil water content and electromagnetic meter (EM) to characteize the 3-D spatial distribution of soil properties over a landscape, and (2) measure soil hydraulic properties for given horizons at a subset of locations that are representative of major soil topographic patterns as defined by a geostatistical analysis of PCP and EM measurements and a digital elevation model.

2001-00961 Economic Valuation of Stream Restoration

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Seed Grant; Grant 2001-35106-11070; $74,938; 2 Years

Very little economic research has been conducted on valuation of stream restoration. State and federal agencies are struggling with issues of how to justify stream restoration by cost-benefit analysis and prioritize restoration projects among the numerous degraded streams given limited budgets. This research addresses agency need for economic values by designing a survey mechanism for valuation of stream restoration. This survey mechanism will be employed on watersheds in West Virginia where acid mine drainage problems exist.

The values from stream restoration by both users and non-users will be derived by the contingent valuation method. Initially, small focus groups held in watersheds throughout West Virginia will be employed to determine uses and interests for restored streams. From focus group information, stream restoration alternatives will be developed and presented to respondents in a survey format. Alternatives will include the full range of restoration possibilities, including the current condition, various partial restorations, and full restoration. Economic value measures will be extracted by including restoration cost in each alternative. In addition, a maximum willingness-to-pay question for a respondent's preferred restoration alternative will be asked to scale individual responses. Electronic surveys (laptop and web-based) will be part of the survey design.

The research conducted with this seed grant will serve as a pilot study in support of large scale, multi-watershed study on the economic value of stream restoration throughout the Appalachian region. Surveys designed in this research will assist in efficient collection of valuation data in various watersheds across the region. Data from this multi-watershed study will be used to develop an information base for determining stream restoration values throughout West Virginia and the Appalachian region.